Federal Office
of Civil Protection
and Disaster Assistance

Recommendations on Sampling for Hazard Control in Civil Protection

On the analysis of chemical, biological and radioactive contamination

5

CIVIL PROTECTION RESEARCH

Recommendations on Sampling for Hazard Control in Civil Protection

ON THE ANALYSIS OF CHEMICAL, BIOLOGICAL AND RADIOACTIVE CONTAMINATION

VOLUME 5

Federal Office
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Recommendations on Sampling for Hazard Control in Civil Protection

On the analysis of chemical, biological and radioactive contamination

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Introduction

Introduction

These recommendations on CBRN-sampling (chemical, biological, radiological and nuclear) were developed by the Federal Office of Civil Protection and Disaster Assistance, in cooperation with representatives of different expert institutions (Federal Office for Radiation Protection, Robert Koch-Institute, Research Institute for Protective Technologies and NBC Protection, Regional Office for Nature, Environment and Consumer Protection of North Rhine-Westphalia, Research Centre Karlsruhe) as well as representatives from the fire brigade sector (professional fire brigade of Mannheim, fire brigade of Herzogenrath and the plant fire brigade of Merck).

The results of a study on the "development of a B-sampling approach in extended civil protection" by the Federal Office of Civil Protection, which was based on the equipment of the Federation, are integrated into the recommendations. They serve as an introduction to, and preparation for, the subject of "emergency sampling" by operational staff during a hazardous situation. They are to ensure the protection of the operational staff, the population and the environment during the sampling and transport of suspicious B-, C- and RN samples and to guarantee a consistent standard when samples from the environment are taken. By doing this, the appropriate responsibilities of the expert authorities, according to the law in force, have to be taken into account.

To make the taking of samples easier for the operational staff, short guide instructions were developed, laminated and added in a supplement. They are designed to be used during exercises and operations.

This manual provides a general description of CBRN-sampling and the protection against CBRN-hazards.

Sampling in the area of biological hazards is of outmost importance, as reliable detection in the field is not possible at the moment.

Where CBRN is concerned, sampling complements direct measurements on site (they are possible for RN and C), if the release of hazardous substances – caused by an accident or a deliberate action (manipulation) – is suspected. Thus, further investigations in the laboratory are made possible.

The authors and information providers endeavour to present information of high quality at all times. The recommendations on sampling for hazard control in civil protection were carefully prepared by the Federal Office of Civil Protection and Disaster Assistance (BBK), in cooperation with other authors. Nonetheless, the authors accept no responsibility for the currency, accuracy, completeness or quality of the information provided. Claims of liability against the authors which relate to damages of a material or ideational nature, and which are caused by the use or non-use of the information provided or by using erroneous or incomplete information, are excluded on principle.

Reference:
The english version differs to the german version in matters of shortages regarding comments concerning only german specific conditions.

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Requirements concerning Sampling

2.1 Preliminary preparations

To be prepared for a hazardous situation and its handling in the best possible way, it is necessary to develop structures for the cooperation of the operational staff on site and the expert authorities (e. g. environment and health as well as veterinary authorities). If possible, these structures should already be in place beforehand. For the sampling procedure, it is also necessary to make materials available, which can be easily handled, and which allow reaction according to the situation. We refer you to chapter 3 “Survey of materials” which contains some recommendations.

The sampling should be done under the guidance of an expert advisor and following the instructions of the incident commander. Only after having established contacts, ensuring the transportation and the treatment in the laboratory, should the team go ahead with the sampling process. Further treatment of the samples is done in the research laboratory. The results are then evaluated in coordination with qualified experts on site and at the research laboratory.

Before the sampling, the existence of explosive substances, radioactive and dangerous chemical substances must be checked. If these hazards occur, they must be taken into account during the further procedure.

Since it is not possible to predict the scenarios which make sampling necessary, the equipment used must be suitable for a wide range of sampling procedures (liquids, solids, gaseous samples, wipe and swab samples, food samples etc.).

Check-list

Preliminary preparations and on-going updating:

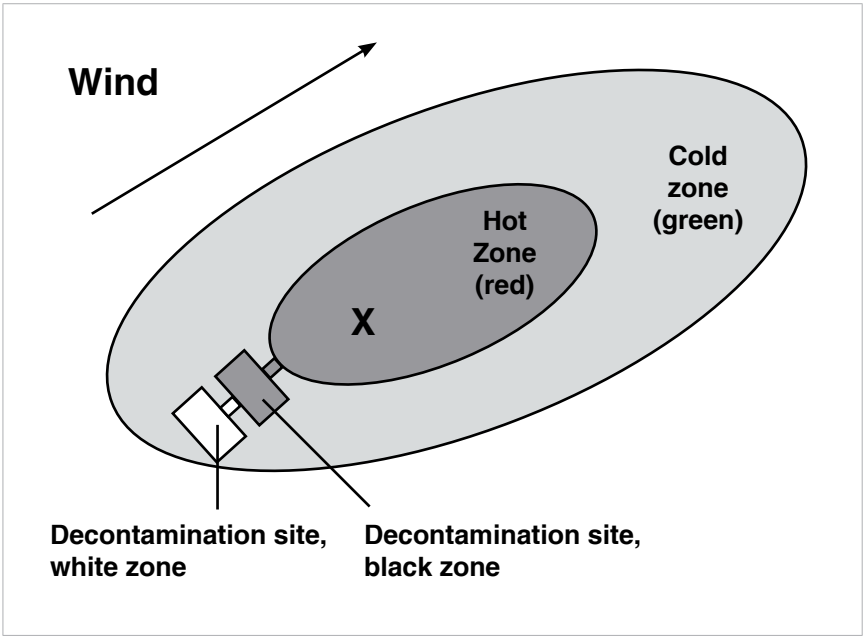
- Choice of laboratories and laboratory capabilities /competences (see appendix)
- Participation of expert authorities in the development of operational plans
- Training of operational staff, including the use of Personal Protective Equipment (PPE)
- Internal availability of staff / materials / equipment etc.
- Ensure availability of expert advice for evaluation / counselling of incident commander
- Clarification of responsibilities

2.2 Protective and special equipment

Due to the many different operational situations and the resulting hazards, appropriate measures for the physical protection of the operational staff must be developed with respect to the sampling procedures which are carried out during CBRN-operations. Appropriate Personal Protective Equipment (PPE) and respiratory protection must be chosen conforming to the appropriate standards, rules and regulations. As to the role of the fire brigades, the incident commander has to make a decision about it, by defining the appropriate equipment on behalf of his team according to the existing national rules and regulations e.g. in Germany fire brigade regulations 7 (respiratory protection) and 500 (units at an ABC-operation) as well as other regulations (FwDV). It is also necessary to clarify whether special state of the art protective equipment is necessary.

2.3 Decontamination

The national rules and regulations concerning decontamination must be considered. In Germany the requirements of the FwDV 500 and of the German Fire Protection Association e.V.(vfdb) RL 10/04 with regard to the decontamination of operational staff and sample containers must be observed. This means that, according to the state of the operation (hazard groups II and III), a decontamination site must be constructed in time.



Picture 1: Possible classification of the different zones if an aerogen dispersion of dangerous agents is suspected (according to FwDV500)

2.4 Risk Assessment - Analysing the incident

Before the operation, an assessment of the situation is necessary. Based on its result, an operation strategy must be determined. The site of the release must be secured and the further cross contamination must be avoided as far as possible. The aim of the operation is to get further information about the incident. The sampling serves to secure the substances, above all for the examination of the samples in the laboratory. Furthermore, each sample is an image of the real operational situation, as it presents itself at the moment of the sampling with regard to the amount of contamination by hazardous substances. Against this background, it makes sense to start with the sampling process as early as possible and to take more than one sample. This is particularly true for the sampling of air-transported hazardous substances.

Based on available information, geographical conditions and weather data, the location of the decontamination site and of the operation control as well as the course of action to be taken by the sampling team are defined.

Before the sampling, the availability and readiness of a pre-defined suitable laboratory and the transportation of the sample there must be assured.

It is good practice to establish direct communication with the responsible laboratory while the sampling procedure takes place.

The coordination with the police must be assured if it is necessary to preserve evidence (criminal investigation).

If necessary, interdisciplinary investigation teams should be established. The squad leader or a predetermined person then ensures the entire external communication.

Exposed people must be evacuated from the contaminated area as quickly as possible. During evacuation further spread of the possible agent has to be avoided.

People must be decontaminated and, if necessary, be medically treated. The affected people must be registered and be kept under surveillance until further measures can be determined.

Check-list for the site of operation	
What happened?	Police findings, clinical symptoms which might have occurred.
When did it happen?	Monitoring of the timeline to be able to draw possible conclusions as to the hazardous substances and their spread (symptoms, incubation time).
Where did it happen?	If possible, delimitation and cordoning of the contaminated area. Did the contamination spread? Scenario: hazardous material accident, attack?
How did it happen?	When, e.g. ‚biological agents are released, information about the kind of release is important. If there is an epidemic, special attention must be paid to transmission and infection routes.
What kind of area is it?	Is it a closed building or An open air scenario? What are the environmental conditions like? Weather, topography, development etc.
What are the environmental conditions like?	Weather, topography, development etc.

2.5 Expert advisors

CBRN-operations can develop into extremely complex situations. Often, the operational staff who arrive first at the scene of the incident do not have sufficient expert knowledge to safely manage the operation.

Therefore, in anticipation of incidents, it is strongly recommended that appropriate expert advisors be found who do not belong to the fire brigade and involve them in the mission planning to give them an overview of the work of the fire brigade. Chemists, biologists, physicists, engineers from relevant disciplines, toxicologists and physicians are particularly suitable.

Via the on site commander, expert advisors can become involved in the fire brigade operations according to the national rules und regulations. We would like to refer, once again, to German FwDV 100 and FwDV 500 where further offices for expert advice are mentioned.

The incident commander and, during large-scale operations, the officer in charge of the section "detection" (FwDV 500) respectively initiate the formation of a sampling team. Before the start of the operation, they determine the sampling strategy, together with the expert advisor. A situation plan should be developed which allows entry to the locations of the sampling. Depending on the situation, the sampling team decides about future sampling strategies on site.

2.6 Sampling team

Principally, the sampling team consists of at least two people, the person who takes the samples and somebody who assists him. Furthermore, a third person who manages the communication with the back-up sector and the documentation of the sampling process (video-, photo- and written documentation), should be planned in. The defined functions must remain unchanged during the entire sampling procedure.

The sampling team only starts when a decontamination and rescue team is ready, as the activities take place in the defined, potentially contaminated, area (hot zone) until the location of the sampling is reached. The distribution of tasks among the team members should guarantee that there is always one "clean" team member (assistant). The person who takes the samples (dirty) is responsible for the prioritisation of the sampling points and actively takes the samples.

The task of the "clean" assistant is the preparation and handing over of the material to ensure a smooth sampling process. If the team consists of two people only, the clean assistant is also responsible for the sample documentation (labelling of the containers, written documentation) and communication. To minimise the spread of the contamination, the clean assistant should not get in direct contact with the substances to be examined. If necessary, the team must be expanded, according to the situation.

The removal of the samples and of the documentation form from the sampling area after the operation must be planned and defined beforehand, for example a camera with a case for underwater photography which allows its decontamination. It is possible to decontaminate and remove documentation forms in sealed transparent bags, together with the samples, without risking any loss of information.

Special attention should be paid to two points:
1. The safety of the sampling team has highest priority.
2. A further spread and contamination by the sampling team must be avoided.

2.7 General information about the sampling procedure

In general, the following holds true for the sampling procedure:

- The sample should be representative of the sampled substance and area. In an emergency case, it is not always possible to stick with this requirement. Samples can be solid, fluid, gaseous or vaporous. Therefore, it is difficult to take a representative part of the sample.
- The sampling tubes and equipment must be durable and clean. According to the incident, a decision has to be made as to whether only one or several kinds of sampling are necessary.
- As a matter of principle, leaking unknown hazardous material should always be sampled.

During a hazardous situation, samples are taken to be able to furnish quick proof about the presence or absence of the hazardous substance and to contribute to its identification. As a rule, this is qualitative proof. At the moment, a standard for sampling during a hazardous situation does not exist. As far as fire brigades are concerned, in Germany the valid vfdb-regulations are applied. During a hazardous situation, the existing standards, e.g., high quality sampling for industry and environment or the food industry, can only be implemented to some extent. To achieve such a standard, exhaustive and time-consuming planning is necessary which is under the responsibility of the respective expert authority or institution.

Depending on the kind of release, the contamination is visible or invisible.

Visible contamination:
If the contamination is visible, the sample of the suspicious substance should be taken, if possible, without mixing it with other substances found on the sampling site.

Invisible contamination:
Invisible contamination can, e.g., occur when aerosol (release of agents in airborne particles) is released. If that is the case, sampling directly from the air or exposed surfaces might be necessary. If a particle cloud moves past to leave particles behind, soil, water and the surfaces of objects (e. g. vegetation) can be contaminated. Among others, the concentration of the particles, air current conditions (wind, ventilators, air conditioning etc.) influence the location and extent of the surface contamination.

For the prioritisation of the sampling procedure, depending on the scenario, the following priority levels are recommended.

Priority level 1:	Sampling in areas where contamination is very likely or when people are in danger. These samples take precedence over other samples.
Priority level 2:	Sampling is necessary in areas where contamination is possible.
Priority level 3:	If the likelihood of contamination is only moderate and doubtful, sampling only takes place when sampling capacities are available.

Further points to be paid attention to during the sampling process:

- If possible, two samples (main and reserve sample) are taken from each defined sampling site, preserved in two independent sample tubes and clearly marked accordingly, e.g. a sample number with the respective addition S (main sample) or R (reserve sample).
- If possible, control samples are taken from outside the contaminated zone to identify falsely positive samples (evaluation of the basic contamination).
- Samples are to give a representative survey of the dispersion of an agent (whether the operation time allows this, has to be calculated, prioritisation of the sampling).
- Sampling along the possible dispersion, and depending on the scenario, is necessary to give a statement about the spread of the contamination and to be able to gauge the number of exposed persons. When the sampling area is defined, dispersion models, taking into account weather data, should be used, if possible.
- If the source of the release can be detected, samples should be taken from there to identify the substance (lead substance, biological agent) (only B, C).

Before the start of the operation, the sampling team decides about the respective procedure.

2.8 Documentation

A comprehensible and clear documentation is the basis for the evaluation of the samples and therefore an important component of the sampling process. The kind and realisation of the documentation should be determined beforehand.

To identify the samples, the individual sample tubes are labelled (numbering) or distinguished by respective labels (suggestion for numbering: licence number plus serial number).

More detailed documentation should be written down in a sampling process document (s. appendix, p. 160). Additional header data, such as place, date, time, sample taker, name/sampling team, unit, weather and temperature are entered in this document. Further information for the later analysis of the sample is, e.g., the aggregate state of the sample, observations concerning the environment of the sampling location (perished animals, discolorations, smoke etc.). Together with the sample, the sampling document is sent to the respective laboratory. The sampling process must be appropriately documented in the operation report (operation form, records etc.). The establishment of a sample collection point would make sense (p. 28). Please see page 160 ff. of the appendix for examples of a sampling documentation.

Generally, a complete weather report message should be prepared at the operation site.

Additionally to the written documentation, a video- or photo documentation would make sense. Beforehand, a methodology concerning the removal of the equipment and the information gained by the decontamination process should be developed. For digital cameras, e.g., water-proof packaging is available at diving sport retailers.

At a minimum, the sample documentation should contain the following information: RN/B/C

- Date
- Name of the sample taker – responsible fire brigade/contact control centre
- Sample number
- Location of measurement
- Time
- Unit/sampling team
- Weather (weather report message)
- Kind of sample
- Observations from the environment of the sampling location (perished animals, discolorations)
- Draft of the sampling location

RN	C	B
Dose rate at the location	Smell Smoke Temperature pH-value	No further information

2.9 Sample collection point

It is recommendable to collect the decontaminated sample tubes at one location. After their completion, the decontamination measures and information about the used substance should be noted down in the sampling form.

At the sample collection point, a documentation to be included in the operation form might make sense. Besides the verification of the unequivocal documentation and the comparison of the entries in the operation form, a sample collection point ensures the correct distribution among the specialist laboratories by observing the respective regulations (labelling). All these procedures must be clearly and intelligibly documented. Operations have shown that it makes sense to connect this sample collection point to the threshold range (black/white) of the decontamination point (p. 18). Together with the staff who have to be contaminated, the samples can then pass the decontamination point. The sample material itself must not get in contact with the decontamination solution.

2.10 Packaging and transport of samples

Definitions

As the samples belong to the category of hazardous goods, their transport on the road should observe the regulations of ADR1[1]. If it was not possible to prepare for a sample transportation beforehand and if the transportation of the samples serves the "emergency transportation for the rescue of human life or for the protection of the environment" (ADR part 1: 1.1.3.1e, exemption in connection with the kind of transportation execution), it is possible to deviate from the regulations, as long as all measures for the completely safe execution of the transportation were taken and therefore a threat to the carrier and the laboratory staff is excluded (biological threats l). In the case of transport the national laws and regulations must be observed.

If possible, the packaging of the samples for transportation to the responsible laboratory should be done in a standardised way.

For biological samples, the packaging regulation P620 regarding dangerous infectious substances, category 6.2, should be observed. It consists of three parts.

Inner package

The inner package consists of a liquid-tight primary tube (corresponds to the sample tube) and a secondary packaging. Between these two parts of the packaging, absorbent padding material is inserted, which is able to completely absorb leaking liquids.

1 Appendix A and B of the European Agreement of 30 September 1957 about the international transportation of hazardous goods on roads

At least one of the tubes must have an approval as packaging category 6.2. irrespective of the packaging temperature, this means the following:

– Stability at an internal pressure of 95 kPa,
– Temperature range from – 40° C up to + 55° C without leaks, certified by the Federal Institute for Materials Research and Testing (BAM).

With regard to packaging, the approved tube is, as a rule, the secondary tube of the inner package.

Outer case

The outer case is a sufficiently stiff and solid case (e. g. cardboard packaging with labelling).

Primary tube

The inner package consists of the primary tube, which can be a bottle (glass or plastic), bag or special packaging for test tubes. As the filling of the sample in the primary tube takes place in the contaminated area, the outer surface must be treated according to the measures defined for RN, B or C (s. part I, II or III). At the sampling site, the primary tube is always packed, together with the sampling form, in a leak proof PE-bag, which can be sealed. When it is taken away from the hot zone, it is dipped into disinfectants at the decontamination point (transit hot/warm or black/white). The sample materials themselves must not get in touch with the disinfectant.

After the necessary reaction time is over, the sample bags are taken out of the dipping bath, the surface is dried and, at the sample collection point, the samples are put in the secondary tube of the inner package. The assistant who is responsible for this task is in the white zone of the decontamination point.

With the outer case, the secondary tube is stored separately, away from the other sampling equipment. It is not taken to the hot zone but stays in the cold zone. Thus, a cross contamination is avoided.

Picture 2: Example of packaging according to P620:
1 primary tube (sample tube),
2 PE-bag (water-proof) which can be sealed and is dipped at the decontamination point,
3 secondary tube stays in the green zone and serves as safe transport packaging to the laboratory (for P620, BAM certified),
4 outer case, cardboard packaging, certified for B-samples, category A.

3

Survey of materials

Quantity	Kind	To be used	Available
4	PE[1]-bottle, 1,000 ml, wide mouth	RNB	laboratory trade
2	PE-bottle, 500 ml, wide mouth	RNB	laboratory trade
6	PE-bottle, 250 ml, wide mouth	RNB	laboratory trade
6	glass bottle, 100 ml, wide mouth, coated	CBRN	laboratory trade
6	glass bottle, 250 ml, wide mouth, coated	CBRN	laboratory trade
2	glass bottles, 500 ml, wide mouth, coated	CBRN	laboratory trade
10	PE-tubes, 50 ml	B	laboratory trade
20	2 l PE-bags	CBRN	super market
1	roll of 120-l-bag (rubbish bag)	CBRN	super market
1	water sampling tool from the depth	CBRN	laboratory trade
5	measuring jugs, PE, 500 ml	CBRN	laboratory trade
1	stainless steel ladle	CBRN	laboratory trade
1	stainless steel shovel	CBRN	laboratory trade
3	stainless steel spoons	CBRN	laboratory trade
3	PE-funnel	CBRN	laboratory trade
1	pair of crucible tongs	CBRN	laboratory trade
2	pairs of tweezers (1 pair of hooked tweezers, 1 big pair of tweezers)	CBRN	laboratory trade
1	side cutter	CBRN	DIY-store
1	thermometer (– 10° C up to + 110° C)	CBRN	laboratory trade
20	cable straps, 30 cm	CBRN	DIY-store

1 Polyethylene

Quantity	Kind	To be used	Available
1	roll of fabric band	CBRN	stationary/ DIY-store
1	packet of disposable nitrile gloves	CBRN	laboratory trade
1	role of paper towels	CBRN	super market
1	sheet of adhesive labels (water and disinfectant proof)	CBRN	stationary
1	documentation papers	CBRN	to be prepared beforehand, s. examples appendix
2	disinfectant resistant pen	CBRN	stationary
1	clipboard	CBRN	stationary
1	brief instruction (laminated)	CBRN	see appendix
1	Sprayer 1000 ml	CBRN	DIY-store
1	packet of round filter paper, 55 mm	CRN	laboratory trade
1	pH-paper/-rods	CB	laboratory trade
1	knife	CBRN	super market
1	packet of small parchment bags/ flat bags	RN	paper wrapping commerce
4	test kits for swabs with transport medium for bacteria, foam plastic (e-swabs)	B	laboratory trade
4	test kits for swabs with transport medium for viruses	B	laboratory trade
4	swabs without transport medium (foam plastic or cotton)	B	laboratory trade
5	plastic spatula or stainless steel	B	laboratory trade
10	cotton compresses, sterile	B	pharmacy/ chemist's shop
10	isotonic sodium chloride vials, plastic NaCl	B	pharmacy/ chemist's shop
2	syringes with extended point, 50 ml + tube	B	laboratory trade
10	disposable pipettes, 3 ml plastic	B	laboratory trade
12	covering boxes, swabs	B	laboratory trade

Quantity	Kind	To be used	Available
10	autoclave bags	B	laboratory trade
1	role of aluminium foil	C	super market
1	hand pump for gas sorbent tubes	C	laboratory trade
1	tube opener	C	laboratory trade
1	pad of warfare agent tracker paper	C	specialised supplier
1	tin of tracker powder	C	specialised supplier
1	bottle of ethanol	C	laboratory trade
1	bottle of distilled water	C	laboratory trade
2	safety spray bottles 500 ml	C	laboratory trade
6	packet of Tenax®-tubes, rinsed	C	laboratory trade
1	packet of silica gel tubes	C	laboratory trade
10	plastic spatula	C	laboratory trade
1	packet of activated carbon tubes	C	laboratory trade
2	packets P620 with dispatch box	B	commercial packaging

Table 1: **Example of a material list for a simple CBRN-sampling kit**

4

C-Sampling

4.1 Recommendations for C-operations

If a contamination with chemical substances is suspected and it becomes necessary to identify the substances, samples must be taken. At the moment, no single measuring device is known which is able to detect the identity of an unknown chemical substance on site with total certainty. This can only be done in a laboratory by applying different measurement methods/verification procedures. In coordination with the expert advisor, the head of operations will decide about the necessity of sampling.

4.2 Protection of the operational staff

During unclear situations with unknown substances, a Self Contained Breathing Apparatus (SCBA) with a gas tight protective suit should be used. If the hazardous substance and its characteristics are known, the protection level can be adapted according to the demand to facilitate the work of the operational staff (table 2).

Thanks to its low weight and its wide-band chemical resistance, the liquid-tight splash suit (according to EN 14605) is well equipped for sampling processes. The national rules and regulations concerning PPE must be observed!

Type	Definition	Standard
1	Protective clothing against liquid and gaseous chemicals, including liquid aerosols as well as solid particle- and gaseous-tight chemical protective suits – part 1: requirements for ventilated and non-ventilated “gas-tight” (type 1) and “non-gas-tight” (type 2) chemical protective suits – part 2: requirements for gas-tight (type 1) chemical protective suits for emergency teams (ET)	EN 943-2 EN 943-1
2	Protective clothing against liquid and gaseous chemicals, including liquid aerosols as well as solid particle- but non-gaseous-tight chemical protective suits – part 1: requirements for ventilated and non-ventilated “gas-tight” (type 1) and “non-gas-tight” (type 2) chemical protective suits	EN 943-1
3	Full body protective clothing with liquid-tight connections between the different parts of the clothing, if applicable, liquid-tight connections between the components gloves, (visors etc.) protective clothing against liquid chemicals – requirements concerning chemical protective suits with liquid- (type 3) or spray-tight (type 4) connections between the parts of the clothing, including the pieces of clothing which only provide protection for parts of the body (types PB 3 and PB 4)	EN 14605

4	Full body protective clothing with spray-tight connections between the different parts of the clothing, if applicable, spray-tight connections between the components (gloves, visors etc.) protective clothing against liquid chemicals – requirements concerning chemical protective suits with liquid- (type 3) or spray-tight (type 4) connections between the parts of the clothing, including the pieces of clothing which only provide protection for parts of the body (types PB 3 and PB 4).	EN 14605
5	Full body protective clothing which covers torso, body and legs and has a barrier against solid suspended particles in the air. Protective clothing against solid particles – part 1: Requirements concerning chemical protective suits which provides protection against air-transported solid particles for the whole body (clothing type 5)	EN ISO 13982-1
6	Full body protective clothing which covers at least the body and the extremities and protects against light spraying, liquid aerosols and small splashes at low pressure and where a permeation barrier is not necessary. Protective clothing against liquid chemicals – requirements concerning chemical protective suits with limited protection against liquid chemicals (equipment type 6 and type PB [6])	EN 13034

Table 2: **Classification of chemical protective suits according to EN**

4.3 Decontamination

The different qualities of a multitude of chemicals exclude a decontamination agent which can be universally applied. To find out whether in case of certain contaminations a successful decontamination of a chemical protective suit is possible, an expert advisor should be consulted. To remove an external contamination from objects, including the sampling materials, thorough washing with warm water and a cleaning agent (surfactants) is in many cases the best recommendation. The same applies to the decontamination of protective clothing to ensure the safe removal of the staff's clothing.

4.4 Execution of C-sampling

Before the sampling, the territory must be inspected to find an appropriate sampling location. The fact that there is often invisible contamination has to be taken into account. This can be the case when gaseous substances are released. The samples can be taken directly from the air or from contaminated surfaces. When a cloud carrying hazardous substances passes by leaving dangerous agents behind, soil, water, the surfaces of objects and vegetation etc. are contaminated. Sampling to investigate contamination dispersion in a calculated direction follows the following criteria:

- Suitable areas should be situated within the calculated dispersion area of a cloud and be exposed and protected against the sun.
- According to the location and area of the dispersion, the responsible professional authority should issue concrete directives concerning kind, location and scope of the sampling.

Recommendations concerning minimum quantities of necessary sample material		
Sampling material	**Quantity**	**Materials**
Solid substances	100 ml	Stainless steel spoon, shovel, bottle
Pastes	100 ml	stainless steel or plastic spatula
Soil, snow (10 cm x 10 cm, 2 cm depth)	200 ml	Stainless steel spoon, shovel, bottle
Ground Vegetation cover (vegetation)	Fill 2 l PE-bag	PE-bag, side cutter
Wipe samples (10 cm x 10 cm)	ca. 100 cm^2	Round filter, 55 mm
Liquids (note down sampling depth)	500 ml	Measuring jug , syringe
Gases	Sorbent tubes	Tenax®, silica gel

Table 3: **Recommended minimum quantities for chemical sampling**

4.4.1 Solid matter samples C01

Powder

If possible, the sampling of suspicious substances should be done without intermixture of materials which are part of the natural environment at the sampling location.

If small quantities of a suspicious substance are released, the entire material must be collected in a test tube. If sufficient sample material is available, a quantity of at least 100 ml must be taken and put in a glass bottle. Larger sample pieces with adherent powder must be packed in an appropriate container (for example, 500-ml-glass bottle). With the spoon spatulas powdery and loose samples can be taken. The crucible tongs help to pick up smaller stones and

objects, the forceps are used for even smaller objects. If possible, the temperature of all materials should be checked and noted down.

Table 3:
appropriate sampling materials for solid substances (from left to right): barbecue tongs, shovel, crucible tongs, spoon spatula small, spoon spatula large, forceps

Pastes C02

Paste-like materials are taken with a stainless steel or plastic spatula. To pack the samples, a 250-ml-glass bottle should be used. For viscous materials, which still flow sufficiently freely, the sample can be taken directly with a syringe. If a tube is used,the tube used for extension should not be too long.

4.4.2 Soil and snow samples C03

For soil and snow samples respectively, the upper surface to a maximum of 2 cm are taken from a surface of 10 x 10 cm, using a stainless steel spoon and packed in a 500-ml-glass bottle.

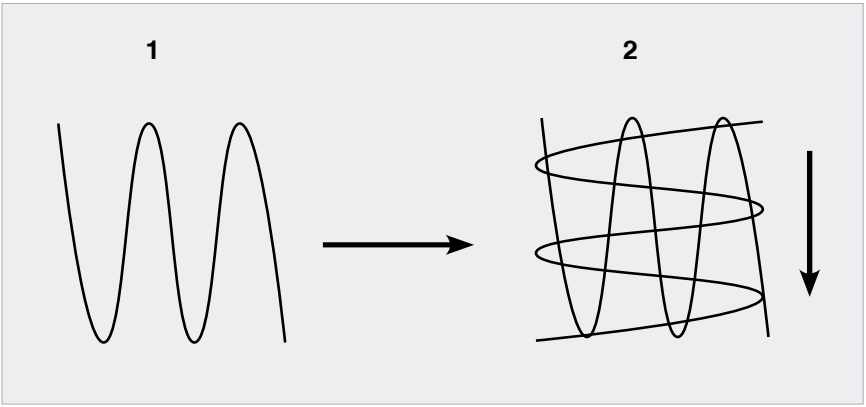
4.4.3 Ground Vegetation samples (vegetation) C04

With the side cutter, samples of objects can be cut off and, for example, pieces of shrubbery and trees be cut out. The knife can be used for objects which cannot be severed by the side cutter. Vegetation samples, preferably leaves from the outer part of a tree/bush, should be cut off with a side cutter or a knife and packed in a 2 l PE-sample bag. In order to avoid the spreading of the contamination, the bag must be turned inside out above the hand. The leaves collected with the bag are cut off and packed by putting the bag over them. If parts of the vegetation are hard and pointed, a solid PE-container should be used instead of the bag. Otherwise, if PE-bags are used, they could be perforated.

4.4.4 Wipe samples C05

A wipe test is done when the surface is contaminated. First, a dry swab is given a try. If the material clings to the surface and a dry swab does not work, a solvent is used. It can be distilled water and ethanol respectively or, according to preference, n-Hexan. The choice depends on which solvent is best able to dissolve the substance. Depending on the situation, the choice should be discussed with the expert advisor beforehand. If the substance is unknown, two wipe samples should be taken, one with distilled water and one with ethanol or another appropriate solvent.

For a wipe sample, a filter paper is used (see picture 4) to wipe over the contaminated surface. If a solvent is used, the filter paper is sprayed with the chosen solvent before the surface is wiped. After the sampling, the paper is folded inside out with the contaminated side inside and packed in a labelled PE-bag. A blank sample (filter paper impregnated in ethanol or distilled water) must be packed separately in a PE bag. If the surface changes during the sampling process, this fact must be noted down in the form.



Picture 4: Realisation of a wipe sample, surface ca. 100 cm²

4.4.5 Liquid samples C06/C07/C08

To obtain liquid samples, a measuring jug, a scoop or water sampling equipment are used. The samples are retained and transported in coated 100-ml or 500-ml glass bottles. The temperature of the liquid which is to be sampled must always be checked and noted down.

To take liquid samples from different depths of waters or containers, for example the water sampling device from the sampling equipment of the federal ABC-reconnaissance vehicle is used. It is a bottle holder with sinker and pull device which was especially designed to take water. The device consists of three parts with the sample bottle (250 ml), the container with clamp and sinker to fasten the bottle, a removable twist bottle top with holes and two cords rolled on a roll (p. 50, picture 5).

The white cord is used to lower the sinker with the bottle. The yellow rope, when pulled, opens the bottle top and thus allows the liquid to enter the bottle through the holes. To take a sample, the bottle in the container is lowered until it reaches the desired depth, opened by pulling the yellow cord, closed again and pulled up. To make it easier to gauge the depth, it is recommended to mark

the white cord accordingly (e.g. knots). The depth of the sampling must be noted down in the documentation.

The sample is then transferred to the encased 500-ml-glass bottle. After having been sealed, it is cleaned and labelled on the outside.

If there is sufficient liquid available, the glass bottles should always be filled right up to avoid trapped air. The sampling equipment, such as measuring jug, water sampling equipment etc., which is used for sampling or the transportation of the samples, must be rinsed once with the sample liquid, before the sample is taken.

Small quantities of liquids or a film of substances which swim on the surface of liquids can be sucked off with the syringe and put into a 100-ml-glass bottle. This procedure must be noted down in the documentation forms.

Picture 5: Example of a water sampling tool

4.4.6 Gaseous samples C09

For the sampling of gases or vapours, sorbent tubes are used.
In the open air, samples are taken 1.5 m above ground level. Downwind, a sufficient distance (ca. five times the height of the building) must be kept from bigger buildings. With his detecting and sampling device, the sample taker positions himself facing the wind.

In enclosed rooms, samples are taken 1.5 m above ground level, directly above the ground and under the ceiling. For the handling of sorbent tubes, fresh disposable gloves should be worn over the normal protective gloves. Thus, a contamination of the tube from outside can be prevented.

The tubes consist of a collective layer, where the substances are adsorbed, and a control layer. Like the collective layer, it is filled with appropriate material and allows adsorption, when the collective layer is saturated ? (breakthrough).

Principally, there are two common kinds of tubes with different substrates.

Silica gel tubes, type G
Among others, the silica gel tubes can be used for the sampling of methanol, phenols, formic and acetic acid, 2-butanon, nitrobenzene, nitro toluene and of phthalates.

Tenax®
Tenax®-tubes contain a polymer with a highly specific surface and a wide band of adsorption abilities, above all for nitroglycerin, polyvalent alcohol and pesticides. The influence of air humidity with regard to Tenax® -tubes is very low. Tenax® is quite temperature stable (up to ca. 375 °C) and is therefore particularly well suited for the later thermal desorption of the sample. The adsorbed amount of substance heavily depends on the substance.
Compared to heavy and nonvolatile substances, light and highly volatile substances can only be adsorbed in small quantities.

After consultation with the chosen laboratory, further substances can be adsorbed.

Illustration 6: **Example of sorbent tubes with tube opener and manual pump**

In order to push a certain amount of air through the tubes, pumps are needed. When hand pumps are used, the following points should be paid attention to: directly before the sample is taken, the leak tightness of the pump must be checked. Therefore, an unopened tube is inserted in the opening, the pump is compressed as far as possible and then released. The pump is sufficiently tight when, after ca. two to three minutes, the scale at the end of the stroke is not yet visible. If the pump is not tight, the instructions should be followed. Per sampling point, two samples should always be taken, one sample with **one stroke** and then one sample with **ten strokes** under the same conditions. Depending on the operation, the procedure has to be coordinated with the expert advisor.

To find out whether the unused tubes are contaminated, blank tests must be examined in any case. They come from adsorption tubes which were kept in stock and transported under identical conditions as the tubes used for sampling. Tubes which were rinsed and stored under protective gas are available which can minimise the problem of unspecific adsorption.

Beforehand, the laboratory, charged with the analysis, and the expert advisor should be consulted to find out what tubes will be used. If a silica gel or active coal tubes are used, they must be taken to a laboratory to be analysed there.

4.5 Further useful equipment

Detection powder

The tracking powder is a mixture of methyl red and methyl orange as pH-indicators for acids. It reacts to warfare agents by a change of colour from yellow to red. This can take up to one minute. It can be used for a rough examination of suspicious traces, but is very unspecific and also reacts to many other substances. This fact has, by all means, to be taken into account.

Detection paper chemical agents

The detection paper is suitable for the detection of liquid warfare agents on surfaces. It takes on the colour of the pattern on the inside page of the cover page. According to the colour change, it is possible to differentiate between warfare agents of the groups G (yellowish), H (red) and V (green). G stands for the nerve agents tabun, sarin and soman, H for the skin agents sulphur yperite (also referred to as mustard gas or yperite) as well as nitrogen yperite and V for the nerve agent VX. The tracking paper even reacts to small quantities. Nevertheless, like the detection powder, it is comparably unspecific.

Illustration 7: **Example of tracking paper and tracking powder**

Universal-indicator paper

The universal indicator paper of, is suitable for showing the pH-value of liquids. The pH-value ranges from one to eleven. When a pH-value is measured, the upper part of the swivel box is turned anti clockwise. The needed strip length is extracted and then turned back and torn off. The strip is moistened with distilled water and dipped into the sample liquid. The humid strip is then compared with the colour scale on the roll and the pH-value is taken. Suspensions, coloured or semi-liquid sample liquids are added by drops onto the strip, and the reverse side of it is compared with the scale. pH-sticks are a very good alternative.

Due to the destruction of the pigment or the release paper, some substances in high concentrations do not allow any measurements.

Illustration 8: **Example of universal indicator paper pH 1-11**

4.6 Transportation of C-samples

As the samples are hazardous materials, the regulations of the ADR must be applied. If the transportation of the samples serves the “Emergency delivery to save human life or to protect the environment” (ADR part 1: 1.1.3.1 e, Exemption in connection with the manner of delivery),the regulations can be waived.

Contrary to biological samples, which can be labelled with the UN-numbers 2900 or 2814, there is no UN-number for chemical samples in the ADR. Chemical substances can have many different characteristics. Therefore, the assignment of a general UN-number would not make any sense.

4.7 Brief instruction about C-sampling

Solid matter samples powder/granulate C01

Note: wear disposable gloves

A

- fill material in a 100 ml-glass bottle (if possible, up to the rim)

B

- close
- clean
- stick on filled out label

C

- wrap bottle light-tight in aluminium foil

Solid matter samples powder/granulate C01

D

- fill out sampling form

E

- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!

Pastes

C02

Note: wear disposable gloves

A

- collect material with spatula and fill it in a 100 ml-glass bottle

B

- close
- clean
- stick on filled out label

C

- wrap bottle light-tight in aluminium foil

D

- fill out sampling form

Pastes

C02

E

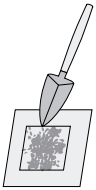
- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!

Soil and snow samples

C03

Note: wear disposable gloves



A

- collect material with stainless steel spatula or spoon
  surface: 10 cm x 10 cm, max. 2 cm

B

- fill material in 250 ml-glass bottle

C

- close
- clean
- stick on filled out label

D

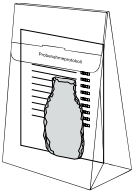
- wrap bottle light-tight in aluminium foil

Soil and snow samples

C03

E

- fill out sampling form



F

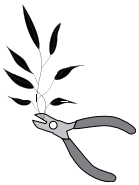
- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!

Ground Vegetation samples

C04

Note: wear disposable gloves



A

- cut off vegetation with a side cutter or knife

B

- fill 2 l-PE-sampling bag

C

- close
- clean
- stick on filled out label

D

- fill out sampling form

Ground Vegetation samples

C04

E

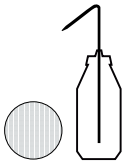
- put sampling-bag and sampling form in PE-bag
- seal

Remember reserve sample!

Wipe samples

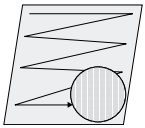
C05

Note: wear disposable gloves



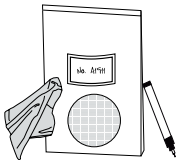
A

- moisten filter paper with solvent



B

- wipe 10 cm x 10 cm-surface with filter



C

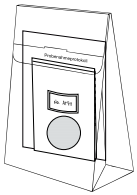
- pack filter in PE-bag
- close
- clean
- stick on filled out label

D

- fill out sampling form

Wipe samples

C05



E

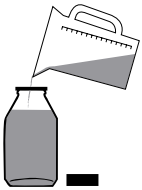
- put sampling bag and form in PE-bag
- seal

Remember reserve sample!

Liquid samples

C06

Note: wear disposable gloves

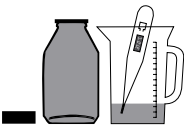


A

- rinse once with the liquid to be sampled
- fill liquid in 500 ml-glass bottle

B

- overfill bottle



C

- measure sample temperature

D

- close
- clean
- stick on filled out label

Liquid samples

C06

E

- wrap bottle light-tight in aluminium foil

F

- fill out sampling form

G

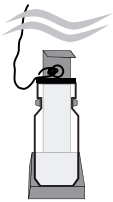
- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!

Water samples from the depth

C07

Note: wear disposable gloves

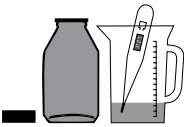


A

- lower water sampling device to the necessary/required depth
- rinse glass bottle once with the water to be sampled.

B

- collect water sample
- overfill 500 ml-glass bottle



C

- measure sample temperature in the flushing water (A

D

- close
- clean
- stick on filled out label

Water samples from the depth

C07

E

- wrap bottle light-tight in aluminium foil

F

- fill out sampling form

G

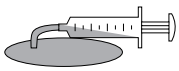
- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!

Liquid or coating

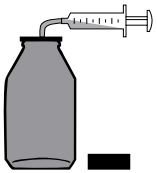
C08

Note: wear disposable gloves



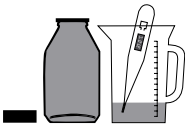
A

- collect liquid, the liquid film or the coating with the syringe, if necessary by using a short piece of tube



B

- fill in 100 ml glass bottle



C

- measure sample temperature

D

- close
- clean
- stick on filled out label

Liquid or coating

C08

E

- wrap bottle light-tight in aluminium foil

F

- fill out sampling form

G

- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!

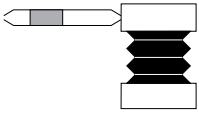
Air samples

C09

Note: wear disposable gloves

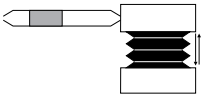
A

- check suction power and tightness of the pump (instructions)
- break off point



B

- attach to pump
  Pay attention to flow direction!



C

- collect sample with appropriate hubs
  (sample I 1 x 1 hub,
  sample II 1 x 10 hubs)

Air samples

C09

D

- close

E

- fill out sampling form
- specifications: complete weather report

F

- put sorbent tubes and form in labelled bag
- pack blank sample and form in extra PE-bag
- seal

Remember reserve sample!
Note: blank sample: unopened sorbent tube from the same charge

5

B-Sampling

5.1 Recommendations for B-operations

If the occurrence of biological agents is suspected, it may be necessary to take samples. This is the case after the accidental or deliberate release of such substances or when confronted with an exceptional epidemic or an unusual outbreak of a disease.

With the agreement of the police and other involved operational staff, sampling measures or coordinated police activities might also be necessary, when a biological threat, based on police findings, is suspected.

Biological threat situations can make the operational staff extremely insecure, because, contrary to chemical or radioactive/nuclear threats, an on-site detection of the probable B-agent in real-time has not been possible so far. To get further insight into the presence or absence of the assumed agent, specific sampling procedures are necessary.

5.2 Protection of the operational staff

The highest risk of infection with biological agents is via the respiratory tract and mucous membrane, via food intake and – this is the case with some agents – also via injured skin (e. g. cutaneous anthrax). Therefore, the protection of the respiratory tract and the eyes should have priority. It is also necessary to protect the body by appropriate clothing. During the planning phase of operations, appropriate protective clothing must be provided and its use be regularly practiced. In Germany the, e.g., vfdb 0806, GUV R 189, GUV R 190 and the manual "Biological Threats I" contain recommendations on protective clothing.

After the completion of the operation, attention should be paid to the professional decontamination and removal of protective clothing. The manual "Biological Threats I" (Biologische Gefahren) and further literature contain certain procedures and the order of the removal of the clothes to minimise the spread of the contamination. During an operation, the head of operations must decide what kind of protective clothing should be chosen.

5.3 Decontamination

When, during a B-incident, potentially contaminated PPE is decontaminated, a disinfectant must be used which can effectively reduce the microbial contamination by chemical or physical inactivation (by at least five log steps). There are no binding regulations for *Bacillus anthracis*. According to current research, a two-per cent peracetic acid solution seems to be the best choice in such a case.

When the sampling team leaves the hot zone, appropriate decontamination measures must be carried out which are based on the instructions by the incident commander and on a consultation with the technical authority (s. paragraph 2.3).

The sampling team should carry along a sprayer with a freshly prepared disinfectant, in order to be able to cover surfaces and gloves between the different operations. The outer pair of gloves must be changed after each sampling and any contact with potentially contaminated material respectively. The inner packaging of the samples and the PE-bag with the sample, to be removed later, should be covered with disinfectant from the outside whilst it is still in the hot zone (chapter 2.3). **Previously, it should be made sure that the disinfectant does not have an impact on the sample labelling.** Preferably, the samples should be dipped at the decontamination site. A tube with fresh disinfectant works best, because it allows a complete dip of the samples into the PE-bag. It is a good idea to have it ready at the transition point between the hot zone (red) and the decontamination point. Trapped air leads to the flotation of the samples which makes it necessary to weigh them down . When the samples arrive at the decontamination point, the sampling team puts them in a tube designed for them. After the expiration of the appropriate reaction time, a member of the decontamination team can remove the samples. The reaction time depends on the following factors:

- the disinfectant used,
- its concentration,
- the temperature,
- the pH-values,
- degree of pollution of the objects which need to be disinfected.

At the sample collection point, the surface of the primary packaging is dried (e. g. wiping with kitchen paper). Then, the samples are packed for transport.

5.4 Execution of B- sampling

For the sampling of biological agents, if possible, sterile or at least clean appliances should be used. To avoid the spread of the contamination between two different samples, fresh disposable gloves must be put on before another sampling takes place. If possible, environmental samples should be packed in disposable materials, such as PE-bags and plastic bottles. Before the start of the operation, the head of operations decides, in consultation with the technical authority, about the locations where the sampling should take place.

The sampling in an outskirt area – to assess the dispersion of a contamination in the wind direction – is carried out according to the following criteria:

- Appropriate areas are situated in the affected/contaminated zone.
- Areas with a high probability of contamination are protected against environmental influences, such as UV radiation .

Due to the release of aerosol, contamination can occur which is not visible and which can be measured by taking a sample from affected surfaces.

In most cases, contamination is not visible. Depending on the location and the area of the release, the responsible technical authority should give specific guidelines as to the kind, location and scope of the sampling. The sampling should also be coordinated with the laboratory in charge.

Sample material	Quantity	Materials
Powder	5 ml – 50 ml	spoon, PE-bottle
Pastes	5 ml – 50 ml	spatula, spoon
Soil (10 cm x 10 cm, max. 2 cm depth)	50 ml	spoon, PE-bottle
Vegetation, loose filling	2 l bag, half of it filled	PE-bag, container, side cutter
Surface Samples Wipes and Swabs	100 cm^2	compresses, swab kit, swab
Liquids (note down depth of sampling)	50 ml	measuring jug, syringe, compress, pipette

Table 4: **Recommended minimum quantities for biological sampling procedures**

5.4.1 Solid matter samples B01/B02/B03

If possible, only the suspicious substance should be collected at the site of the samples.

If small quantities of a suspicious substance are released, the entire material must be collected in a container. If there are sufficient solid matter samples (powder etc.), a part of it (max. 50 g) must be taken. It must be either transferred to a clean unused PE-bottle or a clean unused PE-bag. For biological solid matter sampling, all objects in picture 3, p. 46 are appropriate.

Powder and loose sample materials B01

With the spoon spatula, samples in powder form and loose samples can be taken.

Pastes B02

Paste-like materials can be taken either with plastic or stainless steel spatula or a spoon.

Soil Samples B03

On a surface of 10 cm x 10 cm the top layer to a maximum of 2 cm are taken with a spoon scoop and then packed in an unused PE-bottle.

Reference: If possible, ground samples should be avoided in favour of other samples as the processing of such a sample is difficult.

Further solid substances

With crucible tongs, smaller stones and objects can be taken, a pair of tweezers is used for even smaller objects.

5.4.2 Ground Vegetation samples B04

Ground vegetation samples must be cut off with the side cutter or a knife and packed in a sample bag. To avoid the spread of the contamination, the bag must be turned inside out above the hand. The leaves taken with the help of the bag are cut off and packed by putting the bag over them. When hard and spiky vegetation components have to be packed, a solid PE-container is better than the bag. When PE-bags are used, the risk of perforation is high.

5.4.3 Surface Samples Wipes and Swabs B05, B06

A wipe test is taken when the contamination is finely distributed.

Swab sample B05

If the Surface sample is taken by using swabs, always three swabs are taken from one sample point, provided there is enough material. They include a sterile swab without transport medium, a swab with transport medium for bacteria and one for viruses. Before the sampling, the swabs must be moistened with physiological saline solution.

If the material is not sufficient, first the swab without transport medium is taken.

The area from which the sample is taken should be 100 cm2. The moistened swab heads are brushed over the surface which has to be sampled by performing S- or Z-shaped movements. The swabs are rolled between the fingers so that all sides of the foam material come in contact with the surface. This has to be done in such a way that, the second time, the movement runs in lines which are shifted by 90° (picture 4, page 48).

Swabs with transport medium for viruses and bacteria can be bought in regular laboratory stores. As a rule, they are perishable. It is advisable to discuss this device with the laboratory where the samples are to be analysed. Swabs with foam heads should be preferred to those with cotton heads provided they correspond to the requirements concerning sterility and the necessary transport media.

Wipe sample compress/sponge B06

A wipe sample of biological substances is taken by using sterile compresses or sponges which are first moistened with a sterile isotonic saline solution.[1] Sterile cotton compresses are, for example, available in pharmacies and regular laboratory stores. Swabs should be preferred to compresses. However, compresses are an excellent choice for the final cleaning measures. They are also appropriate for reserve samples.

1 Moistened samples must be immediately analysed in the laboratory to minimise the risk of influencing the sample by accompanied contamination.

Picture 9: **Example of suitable materials for biological sampling: swabs and compresses**

Exceptional cases: diagnostic samples

If the absorption of biological agents via the respiratory tract is suspected, it might be advisable to take a smear from nose and throat. The sampling is done in the cold zone after the decontamination of exposed unprotected people. The samples are only taken by qualified medical staff.

5.4.4 Liquid samples B07/08/09

To take surface water samples, a ladle or measuring jug can be used (B07). The skimmed amount is then transferred to a sample bottle.

Smaller quantities of liquids or coating which swims on the surface of liquids can be sucked off with a syringe or disposable Pasteur pipette (B08). When the quantities of liquids are only small, another possibility is to suck them off with a sterile compress (B09). The methods used must be noted down in the form.

Picture 10: Appropriate sampling tools for taking liquid samples: ladle, measuring jug, syringe

5.4.5 Special samples

Treatment of carcasses

If animal diseases are suspected, the regulations of veterinary authorities must be obeyed (e. g. bird flu, foot and mouth disease).

Food samples

When food samples are taken in suspicious cases, personal protective equipment and decontamination measures can be abandoned – depending on the assessment of the head of operation/expert advisor. When food samples are taken and transported, the regulations of the laboratory in charge must be followed.

5.5 Transportation of B-samples

For the transport of biological samples, the regulations referred to in chapter 2.10. are valid.

The documents referred to in the appendix can, for example, be used as accompanying papers.

If the sample transport time of biological material is well above two hours, adequate cooling (2 – 8 °C but frost-free, not below 0 °C) of the samples is necessary. To achieve this, normal gel-freezer packs can be used which, however, must be cooled beforehand. Preferably, they are packed between the primary and secondary packaging.

5.6 Brief instruction about B-sampling

Solid matter samples — B01

Note: Wear disposable gloves

A

- fill material in 100 ml PE-bottle or PE-bag (at most half-full)

B

- close the bottle

C

- disinfect from the outside
- wipe with a dry cloth
- stick on filled out label

Solid matter samples

B01

D

- fill out sampling form

E

- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

Pastes

B02

Note: Wear disposable gloves

A

- fill material in 500 ml PE-bottle or PE bag (at most half-full)

B

- close

C

- disinfect from the outside
- wipe with a dry cloth
- stick on filled out label

Pastes

B02

D

- fill out sampling form

E

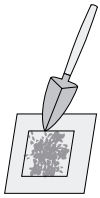
- put bottle and sampling form in PE bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

Soil Samples

B03

Note: Wear disposable gloves



A

- take material with stainless steel scoop or spoon
  surface: 10 cm x 10 cm
  depth: max. 2 cm

B

- fill material in 100 ml-glass bottle (at most half-full)

C

- close bottle

D

- disinfect bottle from the outside
- wipe with a dry cloth
- stick on filled out label

Soil Samples

B03

E

- fill out sampling form

F

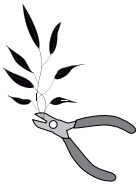
- put bottle and sampling form in PE-bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

Vegetation samples

B04

Note: Wear disposable gloves

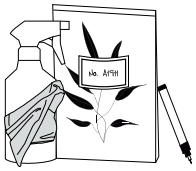


A

- cut off vegetation with side cutter or knife

B

- fill 2 l PE-bag
- close



C

- disinfect from the outside
- wipe with a dry cloth
- stick on filled out label

D

- fill out sampling form

Vegetation samples

B04

E

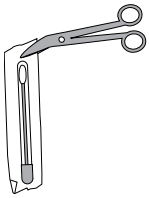
- put 2 l PE-bag and sampling form in PE-bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

Surface Samples Swabs

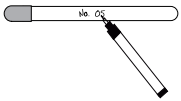
B05

Note: Wear disposable gloves



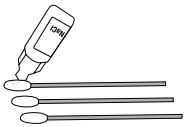
A

- open



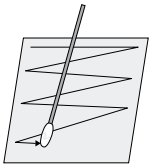
B

- label



C

- open saline solution
- moisten swab heads



D

- wipe surface,
  surface: 10 cm x 10 cm

Surface Samples Swabs

B05

E

- put swab into protective tube

F

- stick filled out label on outer package

G

- put swab in appropriate outer package

H

- fill out sampling form

Surface Samples Swabs

B05

I

- put outer packages and form in PE-bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

Surface Samples Wipes

B06

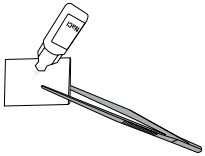
Note: Wear disposable gloves

A

- tear open compress

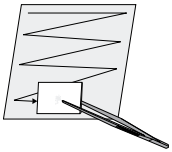
B

- open saline solution



C

- moisten compress with saline solution

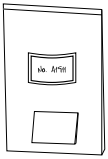


D

- wipe surface, surface: 10 cm x 10 cm

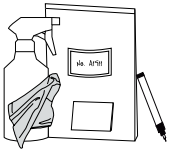
Surface Samples Wipes

B06



E

- pack compress in sterile PE-bag
- close



F

- disinfect from the outside
- wipe with a dry cloth
- stick on label

G

- fill out sampling form

H

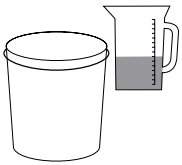
- put bag and sampling form in PE-bag
- disinfect from outside
- wipe with a dry cloth
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

Fluid samples larger quantities

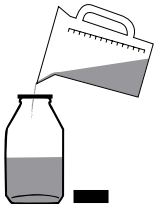
B07

Note: Wear disposable gloves



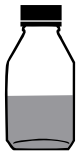
A

- take out sample



B

- fill fluid in 500 ml PE-bag – at most half-full



C

- close bottle

D

- disinfect from the outside
- wipe with a dry cloth
- stick on filled out label

Fluid samples larger quantities

B07

E

- fill out sampling form

F

- put bottle and form in PE-bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

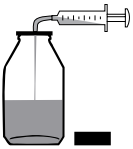
Fluid samples small quantities

B08

Note: Wear disposable gloves

A

- take out sample



B

- fill fluid in 50 ml PE-bottle – at most half-full

C

- close bottle

D

- disinfect from the outside
- wipe with a dry cloth
- stick on filled out label

Fluid samples small quantities

B08

E

- fill out sampling form

F

- put bottle and form in PE-bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

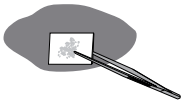
Fluid samples coating, puddles

B09

Note: Wear disposable gloves

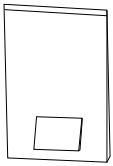
A

- tear open compress



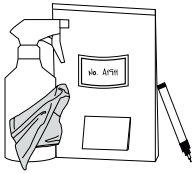
B

- take sample



C

- put compress in PE-bag
  close bag



D

- disinfect from the outside
- wipe with a dry cloth
- stick on filled out label

Fluid samples coating, puddles

B09

E

- fill out sampling form

F

- put sampling bag and form in PE bag
- seal

Remember reserve sample!
When you leave the contaminated area (decontamination point), dip bag!

6

RN-Sampling

6.1 Recommendations for RN-sampling

The sampling by first responders, such as the fire brigade, in a radioactive contaminated area is only necessary in special cases. It is possible to detect on site whether radioactive contamination has occurred. The local dose rate and count rate respectively is measured with suitable equipment (local dose rate measuring device, contamination detection device) directly on site. Specially trained staff of responsible local authorities identify radionuclides and take samples, if necessary. The identification of nuclides can also be done directly on site (in-situ-measuring procedures). There is no acute time problem. For immediate response in civil protection the statement “contamination yes or no” is important as well as the pollution caused by this contamination (local dose rate, counting rate).

Therefore, sampling is, above all, taken into consideration in order to conserve evidence during a special situation, such as the release of radioactivity into flowing water or the assessment of water for fire-fighting operations. That is why only the following radiological samples will be important for the fire brigade: ground vegetation sample, liquid sample and wipe sample. The taking of material for on-site measurements, is not referred to as sampling.

6.2 Protection of the operational staff

If an operation takes place in a radioactively contaminated area, the absorption of radioactivity in the body (incorporation) must be excluded by all means. The protection of the operational staff against contamination is necessary. Normally, disposable tear-resistant suits, approved for radioactivity, gloves, overshoes and full face masks with respiration filter (ABEK2-P3) are sufficient. Alternatively powered and supplied air respirators can be used.

The operational staff must observe the appropriate fire brigade regulations and take suitable measuring devices with them. In case of alpha-contamination, in addition, a contamination monitor to find the best possible sampling site is helpful. Within the RN-area, the following protective measures should be paid heed to: distance from the hazardous source, minimisation of the residence time, to plan and use screening against the agent.

6.3 Decontamination

If people are contaminated, the removal of the contaminated items of clothing (protective clothing respectively) is the most effective measure. Incorporation of the radioactive substances must be avoided by all means. On site, water or water with a surfactant-additive is normally sufficient as decontamination agent. At the periphery of the cordoned off area, each sample must be packed in an additional transportation bag and properly sealed. The spread of the radioactive material onto the surface of the outer package must be avoided. After checking that the bag is free of contamination, this must be documented on the bag. Furthermore, the local dose rate of the sample container (contact) must be measured and be documented on the transportation bag.

6.4 Execution of RN-sampling

Within the RN-area, only samples from flowing water, wipe and vegetation samples are taken. The fire brigade is not entitled to initiate analytical examinations or an approval.

The course of the sampling, the analysis, evaluation, assessment and reporting must be completed as fast as possible.

Before the sampling, the area must be examined. In coordination with the incident commander, the sampling is determined on the basis of the values measured by dose rate meters and the contamination monitor respectively.

The materials, listed up in table 5, are needed to take samples. The quantities stated there, must at least be taken as samples to allow a sensible analysis in the laboratory.

Sample material	Quantities	Materials
Vegetation samples	2 l PE-bag, half full	PE-bag, jar, side cutter or knife
Wipe samples	> 100 cm²	Filter paper, 55 mm, parchment bag
Liquids (note down depth of sample taking process)	1000 ml	Water sampler, measuring jug, syringe, compress, PE-bottle

Tab. 5: **Recommended minimum quantities for radiological sampling**

6.4.1 Ground Vegetation Samples (vegetation) – RN01

Leaves from the outer part of the tree/bush must be cut off with the side cutter or knife, packed in a sample bag and tightly sealed.

To avoid the spread of the contamination, the bag must be turned inside out over the hand. The leaves seized by the bag are cut off and packed by covering them with the bag. The mechanical damage of the bag must be avoided. For hard and pointed vegetation components a solid PE-container should be used instead of the bag. If PE-bags are used, there is the danger of perforation.

6.4.2 Wipe samples – RN02

Radiological wipe samples can only be taken from dry and, if possible, smooth surfaces. The wipe sample is taken with dry filter paper (diameter: 55 mm). To this end, a surface of at least 100 cm^2 is wiped by applying slight pressure (illustration. 4, page 48). The wipe test paper must beforehand be numbered so that the wipe test can be allocated to the references in the form. The wipe sample must be taken with the side of the paper which had been marked accordingly. The wipe test must neither be folded too much nor mechanically damaged. The wipe samples are individually packed in parchment bags. At the periphery of the cordoned off area, they are then collected in a transportation bag which must afterwards be checked whether it is free from contamination. The lack of contamination must be documented on the bag. It is absolutely necessary to note down the quality of the surface and of the wiped surface area in the form, together with the evaluation mission.

Illustration 11: Wipe sampling with labelled filter and size comparison

Sampling from people:
If the ingestion of radioactive substances via the respiratory tract is suspected, the affected people should blow their nose to be tested. This is done in the cold zone after the decontamination of exposed unprotected people.

6.4.3 Liquid samples – RN03

To take liquid samples from different depths of waters or containers, for example the water sampling device from the sampling equipment of the federal ABC-reconnaissance is used. It is a bottle holder with sinker and pull device which was especially designed to take water. The device consists of three parts with the sample bottle (250 ml), the container with clamp and sinker to

fasten the bottle, a removable twist bottle top with holes and two cords rolled on a roll (p. 50, picture 5).

The white cord is used to lower the sinker with the bottle. The yellow rope, when pulled, opens the bottle top and thus allows the liquid to enter the bottle through the holes. To take a sample, the bottle in the container is lowered until it reaches the desired depth, opened by pulling the yellow cord, closed again and pulled up. To make it easier to gauge the depth, it is recommended to mark the white cord accordingly (e.g. knots). The depth of the sampling must be noted down in the documentation.

A scoop or measuring jug can be used to take surface water samples. The skimmed quantity is then transferred to a sample bottle.

The liquid is poured in a 1 l PE wide mouth bottle until it is filled right to the bottle neck. To avoid contamination of the laboratory, it is not advisable to fill the bottle right to the brim.

6.5 Transportation of RN-samples

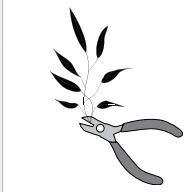
As the samples to be transported are in line with the recommendation concerning the transportation for the protection of man and environment, the exemption according to ADR part 1: 1.1.3.1 e ("Emergency transportation for the rescue of human life or the protection of the environment") is valid. Cf. also chapter 2.10.

The sample containers and sample bags must be labelled accordingly (documentation). By doing this, the special procedure for radioactive sampling must be adhered to. This means that both the outer lack of contamination of the primary package and the local dose rate of the sample container must be measured without additional distance between the container and the measuring device (contact measurement). By doing this, the sample takers should be careful that the measuring device used is not contaminated.

6.6 Brief instruction about RN-sampling

Ground Vegetation Samples	RN01

Note: wear disposable gloves



A

- cut off vegetation with side cutter or knife

B

- fill 2 l-PE-bag
- close bag (no roots, stones, earth)

C

- use a spray bottle to clean the outside
- wipe with a dry cloth
- stick on filled out label

Ground Vegetation Samples

RN01

D

- measure contact dose rate
- note down on the bag

E

- fill out sampling form

F

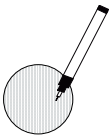
- at the periphery of the cordoned off zone, transfer to a contamination free package
- check whether it is free from contamination
- seal

Remember reserve sample!!

Wipe samples

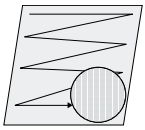
RN02

Note: wear disposable gloves



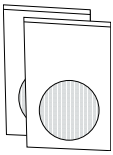
A

- number round filter



B

- filter with the labelled side, wipe surface with a dry cloth by putting on a bit of pressure, surface: 10 cm x 10 cm



C

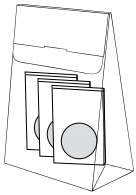
- individually pack different wipe samples in parchment bags

D

- fill out sampling form

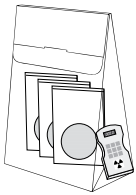
Wipe samples

RN02



E

- at the periphery of the cordoned off zone, transfer bags with wipe samples and form to contamination free primary package



F

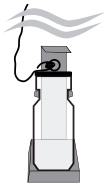
- measure lack of contamination and contact-dose rate
- note down on bag

Remember reserve sample!

Liquid samples

RN03

Note: wear disposable gloves

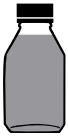


A

- take out sample

B

- transfer to bottle
- fill bottle to the neck
- use funnel



C

- close

D

- wipe
- measure contact-dose rate
- note down on the bottle

Liquid samples

RN03

E

- stick on filled out label

F

- fill out sampling form

G

- at the periphery of the cordoned off zone, transfer bottle and form to contamination free package
- measure lack of contamination
- note down on package

Remember reserve sample!

Appendix

Forms – Checklists – preliminary preperations

Accompanying documents

Examples of sampling forms

Forms – checklists – preliminary preparations

Preliminary preparations and on-going update:

Choice of laboratories and assessment of laboratory capacities/competences

	Chemistry	biology	physics
Address:			
Contact person:			
Name:			
Tel.:			
Fax:			
E-Mail:			

Involvement of technical authorities concerning the development of operation schedules

	Chemistry	biology	physics
Name:			
Telephone:			
Fax:			
E-Mail:			
(replacement)			
Name:			
Telephone:			
Fax:			
E-Mail:			

Training of operational staff, including the use of Personal Protective Equipment (PPE)
Trained are:

Internal availability (personnel/materials/equipment etc.)

Personnel:

Materials/equipment::

Choice of radio channels:

Sample form check-list for the site of operations

What happened?

Description:

When did it happen?

Date:

Time:

Where did it happen?

Address:

Other:

How did it happen?

Incident:

What is the area like?

Pocket card checklist sampling

– always do the sampling twice

– if possible, sampling from the source of the release (only B, C)

– sampling along a possible spread /dispersion

– control sample should be taken from an area which is not contaminated

– label all packages

– fill out form

– pack securely

– take away samples appropriately

Accompanying documents

Handover form sample transportation	Accompanying documents
Hand over 🕓: Name in printed letters	**Accepted** 🕓: Name in printed letters
(Signature and date)	(Signature and date)
Hand over 🕓: Name in printed letters	**Accepted** 🕓: Name in printed letters
(Signature and date)	(Signature and date)
Hand over 🕓: Name in printed letters	**Accepted** 🕓: Name in printed letters
(Signature and date)	(Signature and date)
Hand over 🕓: Name in printed letters	**Accepted** 🕓: Name in printed letters
(Signature and date)	(Signature and date)

Accompanying sheet for transportation

B

UN-Number:

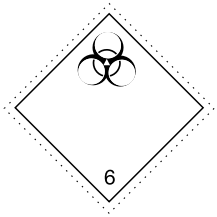
Official name for transportation:

Class: 6.2
Classification code: I4

Number (samples):

Type of sample/of the sample material:

Infectious substance expected to be contained in the sample:



Recipient :
Name:
Institution:
Address:
Tel.

Sender
Name:
Institution:
address:
Tel.

Place/date signature sender

Accompanying sheet for transportation if agents of category A are suspected

B

UN-Number: 2814 or 2900

Official name for transportation:

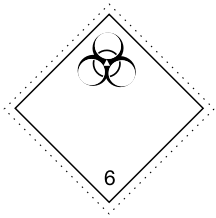
("Suspected to be infectious substance of category A")

Class: 6.2
Classification code: I1or I2

Number (samples):

Type of sample/of sample material:

Infectious substance expected to be contained in the sample:



Recipient :
Name:
Institution:
Address:
Tel.

Sender
Name:
Institution:
address:
Tel.

Place/date signature sender

Examples of sampling forms

C-measuring and sampling form			
Order/operation number		Date	Date
Sampler/measuring vehicle			

1	Measuring point/sampling site Predicted jeopardised area Measuring point/sampling site UTM Ref. coordinates	

2	Protective equipment (fill out if not default)	Form 1 ☐ (fire protective clothing)	Form 1 ☐ (splash suit)	Form 1 ☐ (gas tight suit , fully encapsulating suit)
		Filter ☐	PA ☐	

3 Quick test(s):

Consecutive no.:	Kind of tests	Time	Measuring point and measuring height	Result: (mark, number, discoveries)		Remark	
1	pH-value ☐						
	Oil evidence ☐						
	Water evidence ☐						
	Search for leak ☐						
2	pH-value ☐						
	Oil evidence ☐						
	Water evidence ☐						
	Search for leak ☐						
3	pH-value ☐						
	Oil evidence ☐						
	Water evidence ☐						
	Search for leak ☐						

4 Measuring equipment/detector tubes:

Consecutive no.:	Detector tube no. Simultaneous test no. Used measuring device (e. g. PID, IMS, Ex etc.)	Time	Measuring point and measuring height	Completed number of strokes	Reading /mark (1., 2. etc.)	Unit (ppm. before), mg/m3, (UEG etc.)	Remark such as sensor designation or choice of gas, what to do when colour changes
1							
2							
3							

5	Sampling:					
	Consecutive no.:	No. of cartridge, bag or bottle	Time	Measuring point and measuring height	Completed number of hubs	Remarks Air/gas wipe test Pure substance soil Liquid/water/fire fighting water
	1					
	2					
	3					
	Handed over to sample collection point (place) / laboratory (address)					

6	Meteorological values (to be filled out if different from C-situation report):					
		Sunshine		sky more than 50% Clouded		Sky less than 50% cloud cover
		Fog		rain		snow/sleet
	Temperature			°C		
	☐	Wind direction (wind from) in degrees		☐		
	Wind velocity			km/h		
		Strong wind (dust and loose scraps of paper are swirled up)		Average wind force (leaves and thin twigs move)		Light wind (you can feel the wind on your face)
		Very light wind (wind direction visible due to movement in the smoke)		Absolute calm		

Driver	name (printed letters)		signature	telephone-/mobile phone number

Example: Sampling form district of Cologne

Bezirk Köln	**Sampling form**	Number: ___

Voluntary fire brigade:

Contact:

Measuring brigade:

Name

Name

Name

Description of the sampling point (draft)

Draft of map

Remark: The filled out form is packed, together with the sample, in a primary package and handed over to the selected laboratory. The sampling is appropriately documented (e. g. in the operations form).

Water sampling:

Sample identification:

Day: _____ Month: _____ Year: _____ Time: _____

Sampling point: _____

Reason for sampling: _____

Sampling: ☐ immediately ☐ after _____ minutes _____ Litre

Individual sample: ☐

Collective sample: ☐ Duration _____ Minutes _____ Litre

Characteristics of the sample:

Colour: ☐

Turbidity: ☐

Sediment: ☐

Odour: ☐

Other: ☐

Measurements on site:

Water temperature: _____ ° C air temperature _____ ° C

pH-value _____ at _____ ° C

Sampler:

Name: _____ Rank _____

The sample was handed over

on: _____ at _____ (time) _____ to: _____

_____

Ground sampling:

Sample identification:

Day: _____ Month: _____ Year: _____ Time: _____

Sampling point: _____

Reason for sampling: _____

Surface from which the ground sample was taken:
Short description **(10 x 10 cm, 2 cm deep)**

_____

_____

Characteristics of the sample:

Colour: _____

Appearance: _____ (distinctive features)

Smell: _____

Temperature of the ground surface: ____ ° C

Other: _____

Measurements on site:

Air temperature _____ ° C

pH-value _____ at _____ ° C (elutriate soil)

pH-value colour change detecting powder from: ____ to _____

Sampler:

Name: _____ Rank _____

The sample was handed over

on: _____ at _____ (time) _____ to: _____

_____

Wipe sample:

Remark:
A blank sample must always be taken. It consists of unused filter paper, which is moistened with some drops of the solvent used.

Sample identification:

Day: _____ Month: _____ Year: _____ Time: _____

Sampling point: _____

Reason for sampling: _____

Sampling: ☐ immediately ☐ after _____ minutes _____

Surface from which the wipe sample was taken: 100 (cm^2) yes ☐ no ☐

Surface from which the wipe sample was taken: ___ (cm^2)

Sampling should only be done on fixed surfaces!

Was a solvent used, if yes, which one? _____

Did the solvent used change
the sampled surface? yes ☐ no ☐ Tick where applicable

Material: _____

Surface finish: _____

Characteristics of the sample:

Colour: _____

Odour: _____

Kind of precipitation: _____

Temperature of the ground surface: _____ ° C

Precipitation (rain, snow): _____

Air sample:

Sample identification:

Day: _____ Month: _____ Year: _____ Time: _____

Sampling point: _____

Reason for sampling: _____

1 stroke ☐
and ☐
10 strokes ☐

Active carbon tubes ☐ Tick where applicable

Silica gel tubes ☐ Tick where applicable

Tenax©-tubes ☐ Tick where applicable

After the sampling process, the two ends of the sampling tube are sealed.

Additionally, an unused sorbent tube is always handed over as a blank sample.

Measurements on site:

Air temperature _____ ° C

pH-value _____ at _____ ° C

Sampler:

Name: _____ Rank _____

The sample was handed over

on: _____ at _____ (time) _____ to: _____

_____

Sampling form:

C	B	RN

1. Sampler: _____ _____
(Name) (**signature**)

2. Operation number: _____

3. Time: _____ _____
(Time) (day/month/year)

4. Place: _____ or UTM ☐☐☐☐☐☐☐☐
(Address/GPS-data)

5. Other: _____

6. Description/special features of the sampling process: _____

Sampling point **Sampling no.**	**Sampling point**	**Solid matter** a. Soil b. Powder c. Plants d. Samples from animals e. Other Quantity:(ml)	**Liquid** a. Surface water b. deeper water layers Quantity:(ml)	**Wipe sample** Surface a. smooth b. rough c. porous Surface (cm^2)	**Swab sample** a. sterile swab b. Bacteria c. Viruses Surface (cm^2)	**Gas sample**	**Remarks**

Sketch of the sampling point: Edge length → _____ Length ← _____ m												